

REMARKS

In the Final Office Action¹, the Examiner took the following actions:

- (a) rejected claims 1, 3, 6, 7, and 27 under 35 U.S.C. § 103(a) as being unpatentable over Capote et al., U.S. Patent No. 6,121,689 ("Capote") in view of Lin, U.S. Patent No. 6,426,556 ("Lin") and Nagarajan et al., U.S. Patent No. 6,639,321 ("Nagarajan");
- (b) rejected claim 8 under 35 U.S.C. § 103(a) as being unpatentable over Capote, Lin, and Nagarajan, in view of Mistry et al., U.S. Patent No. 6,077,726 ("Mistry");
- (c) rejected claims 21, 25, and 28 under 35 U.S.C. § 103(a) as being unpatentable over Capote, in view of Lin, Grill et al., U.S. Pat. App. Pub. No. 2002/0127844 ("Grill"); and Nagarajan;
- (d) rejected claims 23, 26, 29, 33, and 34 under 35 U.S.C. § 103(a) as being unpatentable over Capote in view of Kelkar et al., U.S. Patent No. 6,462,426 ("Kelkar"); Grill, and Nagarajan; and
- (e) rejected claims 30-32 under 35 U.S.C. § 103(a) as being unpatentable over Capote in view of Kelkar, Grill, and Hosomi et al., U.S. Patent No. 5,747,881 ("Hosomi").

No claims are amended in this Request for Reconsideration. Claims 1, 3, 6-21, 23, and 25-34 remain pending, with claims 1, 3, 6-8, 21, 23, and 25-34 under current examination and claims 9-20 withdrawn from consideration.

Applicant notes initially that the Examiner does not mention Nagarajan in his statement of the rejection of claims 21, 25, and 28 on page 6 of the Final Office Action. However, the Examiner does cite Nagarajan against these claims on page 7 of the Final Office Action. Likewise, the Examiner does not indicate that claims 33 and 34 are

¹ The Final Office Action contains statements reflecting characterizations of the related art and the claims. Regardless of whether any such statement is identified herein, Applicant declines to automatically subscribe to any statement or characterization in the Final Office Action.

rejected and does not cite Nagaraian in his statement of the rejection of claims 23, 26, and 29 on page 8 of the Final Office Action. However, the Examiner does indicate that claims 33 and 34 are rejected in the first sentence of the third paragraph on page 8 and cites Nagaraian against these claims on page 10 of the Final Office Action.

Rejection of claims 1, 3, 6, 7, and 27

Claim 1

Applicant respectfully requests withdrawal of the rejection of claim 1.

The key to supporting any rejection under 35 U.S.C. § 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious. Such an analysis should be made explicit and cannot be premised upon mere conclusory statements. See M.P.E.P. § 2142, 8th Ed., Rev. 6 (Sept. 2007). “A conclusion of obviousness requires that the reference(s) relied upon be enabling in that it put the public in possession of the claimed invention.” M.P.E.P. § 2145. Furthermore, “[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art” at the time the invention was made. M.P.E.P. § 2143.01(III), internal citation omitted. Moreover, “[i]n determining the differences between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious.” M.P.E.P. § 2141.02(I), internal citations omitted (emphasis in original).

The Examiner alleged that Capote “teaches a semiconductor chip having ... a low dielectric constant insulating film having a relative dielectric constant of about 3.5 or less formed directly on a surface of the dielectric chip” (Final Office Action at 2). The Examiner also asserted that “benzocyclobutene ... is disclosed in ... this application to be a suitable material” and that “[i]t is inherent that benzocyclobutene has a dielectric constant of about 3.5 or less.” *Id.*

Applicant respectfully disagrees. Capote does not disclose or suggest the use of a dielectric, and certainly not “a low dielectric constant insulating film having a relative dielectric constant of about 3.5 or less,” as required by independent claim 1. Instead, Capote discloses that “the chip 10 is passivated with a thin layer of ... benzocyclobutene” (*Id.*), clearly showing that the benzocyclobutene is used only as a passivation film and not as a low dielectric constant insulating film. Further, contrary to the Examiner’s assertion, since the disclosure of Capote makes no reference to the use of a dielectric or a low dielectric constant film, one would not “inherently” determine any information about the dielectric constant of benzocyclobutene from the disclosure of Capote. Thus, the mere mention of benzocyclobutene by Capote, and for a different purpose than that recited in Applicant’s claimed invention, does not render obvious Applicant’s invention, as recited in independent claim 1.

The Examiner admitted that Capote does not disclose the combination of a low dielectric constant insulating film with “a passivation film formed on a surface of the low dielectric constant insulating film” (Final Office Action at 3). The Examiner alleged that “Lin teaches a dielectric insulating film on a semiconductor surface ..., a passivation film

formed on the insulating film ..., and that the passivation film can comprise multiple layers” (*Id.*). The Examiner cited Lin’s disclosure that “layer 32 of passivation material may comprise several layers of passivation” (Lin, col. 6, lines 31-32) and alleged that “[i]t would have been obvious ... to provide an additional passivation film on the film of Capote as taught by Lin” (Final Office Action at 3).

However, Lin merely discloses “a layer of dielectric that has been deposited over the surface of [a] substrate” (Lin, col. 6, lines 19-20). Lin does not disclose or suggest “a low dielectric constant insulating film having a relative dielectric constant of about 3.5 or less” or “a passivation film formed on a surface of the low dielectric constant insulating film,” as recited in claim 1. Lin’s disclosure of several layers of passivation is irrelevant to claim 1 and does not overcome the noted deficiencies of Lin.

The Examiner also admitted that Capote “does not teach a plurality of second bump electrodes formed on a side of the wiring board opposite to the connection electrodes” (*Id.*). The Examiner cited Nagaraian in an attempt to overcome this deficiency of Capote. However, Nagaraian merely discloses “[a] flip chip ball grid array package includ[ing] a thin die” and forming “a plurality of wafer bumps ... on the thin die for making electrical contact between the thin die and the substrate” (Nagaraian, Abstract). Nagaraian also discloses the use of solder balls 116 between a laminated substrate 108 and a second level package 120. See *id.*, Fig. 4 and col. 1, lines 32-38. Even if the solder balls of Nagaraian are assumed to correspond to the second bump electrodes of claim 1, which Applicant does not concede, Nagaraian does not disclose that the solder balls are “electrically connected to the connecting electrodes,” as

required by claim 1. Further, Nagaraian provides minimal disclosure of the solder balls, which do not appear to be a significant aspect of Nagaraian's disclosure. Accordingly, Nagaraian does not disclose or suggest "a plurality of second bump electrodes formed on a side of the wiring board opposite to the connection electrodes, the plurality of second bump electrodes being electrically connected to the connecting electrodes," as required by independent claim 1. Nagaraian therefore does not overcome the deficiencies of Capote.

Further, the Examiner has repeated his allegation from the July 19, 2007 Office Action that some elements of claim 1 include "product by process" limitations. Applicant disagrees, as explained in Applicant's October 19, 2007 Amendment, and submits that claim 1 recites structural limitations of Applicant's invention. For example, in the October 19, 2007 Amendment, Applicant explained that the added element "a plurality of second bump electrodes formed on a side of the wiring board opposite to the connection electrodes, the plurality of second bump electrodes being electrically connected to the connecting electrodes," as recited in amended claim 1, imparts clear structural limitations on the claimed wiring board. The Examiner is incorrect in labeling any part of claim 1 as "product by process" language. Further, the Examiner alleged that "an old or obvious product produced by a new method is not patentable as a product, whether claimed in 'product by process' claims or not," and cited MPEP § 2113 (Final Office Action at 4). However, nothing in MPEP § 2113 endorses the Examiner's assertion or provides justification for rejecting a claim that does not recite "product by process" limitations as if the claim did recite such limitations. MPEP

§ 2113 provides guidance regarding “product by process” claims, and only for such claims. Applicant’s claim 1 is not a “product by process” claim, and accordingly is not subject to evaluation in accordance with MPEP § 2113.

For at least these reasons, independent claim 1 should be allowable over Capote, Lin, and Nagarajan, separately or in any combination. Applicant therefore respectfully requests withdrawal of the rejection of claim 1.

Claim 3

Claim 3 should be allowable over Capote, Lin, and Nagarajan, separately or in any combination, at least due to its dependence from base claim 1. The Examiner repeated his allegation that Capote “teaches a low dielectric constant insulating film benzocyclobutene” and added that “[i]t is inherent that benzocyclobutene has an adhesion strength of 15 J/m^[2] or less” (Final Office Action at 4). As established, Capote does not disclose the use of a low dielectric constant insulating film, and Capote’s disclosure of benzocyclobutene is merely that of a passivation layer. In addition, the Examiner gave no support for his allegation of an inherent adhesion strength for benzocyclobutene. Adhesion strength, as recited in claim 3, refers to the adhesion strength of the low dielectric constant insulating film to each of the semiconductor chip, the insulating film and a metal film. Since Capote discloses benzocyclobutene only as a passivation film, and contains no disclosure or suggestion of using a dielectric film, one of ordinary skill would not have been led to consider, nor would one “inherently” determine, any information about the adhesion strength of benzocyclobutene from the disclosure of Capote. Lin and Nagarajan, separately or in combination, fail to overcome

at least these deficiencies of Capote. Therefore, for at least these reasons, claim 3 should be allowable over Capote, Lin, and Nagaraian, separately or in any combination. Applicant therefore respectfully requests withdrawal of the rejection of claim 3.

Claims 6, 7, and 27

Claims 6 and 7 should be allowable, at least due to their dependence from base claim 1. Claim 27 should also be allowable due to its dependence from base claim 1. The Examiner alleged that "Capote teaches a low-k dielectric film of silicon nitride" (Final Office Action at 5). As established, Capote does not disclose or suggest the use of a low dielectric constant insulating film. Capote's disclosure of silicon nitride regards its use as a passivation layer. See Capote, col. 10, lines 40-41. Given the disclosure and deficiencies of Capote, this reference to silicon nitride by Capote does not render claim 27 obvious. Also as established, neither Lin nor Nagaraian, nor their combination, overcome these deficiencies of Capote. Thus, for at least these additional reasons, claims 6, 7, and 27 should each be allowable over Capote, Lin, and Nagaraian, separately or in any combination. Applicant therefore respectfully requests withdrawal of the rejection of claims 6, 7, and 27.

Rejection of Claim 8

Claim 8 should be allowable over Capote, Lin, and Nagaraian, separately or in any combination, at least due to its dependence from base claim 1. The Examiner admitted that Capote "does not teach that a part of the connecting electrodes are coated with a passivation film comprising at least one layer formed of an organic film" (Final Office Action at 5). The Examiner cited Mistry for its alleged teaching of

“a passivation film comprising at least one layer formed of an organic film,” and specifically cited Figure 1 of Mistry (*Id.*).

Mistry, however, does not disclose or suggest the use of a dielectric film or a low dielectric constant insulating film, as required by claim 1. Thus, Mistry also does not disclose or suggest a passivation film formed on a surface of the low dielectric constant insulating film, as also required by claim 1. Mistry discloses “forming a polyimide layer (16) over a passivation layer (14)” in order to “reduce[] stress and thus reduce[] passivation cracking and silicon cratering that can be a failure mode in semiconductor manufacturing” (Mistry, Abstract). Mistry also discloses that the “polyimide layer 16 is ... formed over passivation layer 14 ... [but] in a conventional process, the polyimide layer 16 would be pulled back from the edge of the passivation layer 14 in the area where the solder bump is formed” (*Id.*, col. 2, lines 46-49). However, the polyimide layer of Mistry “is not pulled back to the edge of the passivation layer 14, but entirely covers passivation layer 14” (*Id.*, col. 2, lines 52-54). Further, Mistry discloses that “[b]y extending polyimide layer 16 over passivation layer 14, the passivation edge, or boundary area, is protected from chemical ingress, preventing chemicals and other contaminants from causing corrosion and thus improving reliability” (*Id.*, col. 3, lines 14-18).

Thus, the polyimide film of Mistry is not merely a part of Mistry’s passivation film, but rather is a required covering layer that is formed after the passivation layer is formed. Mistry clearly establishes that the “edge of the passivation layer 14” must be “entirely cover[ed]” with polyimide in order to “protect[] from chemical ingress” and

prevent reliability problems. See *id.*, col. 2, lines 52-54, and col. 3, lines 14-18.

Therefore, the Examiner has mischaracterized Mistry in alleging that Mistry's passivation layer, with the polyimide layer formed thereon, corresponds to the "passivation film comprising at least one layer formed of an organic film," recited in claim 8.

Moreover, Mistry does not overcome the deficiencies of any of Capote, Lin, and Nagarajan. Therefore, for at least these reasons, claim 8 should be allowable over Capote, Lin, Nagarajan, and Mistry, separately or in any combination. Applicant therefore respectfully requests withdrawal of the rejection of claim 8.

Rejection of Claims 21, 25, and 28

As established, independent claims 1 and 21 should be allowable over Capote, Lin, and Nagarajan, separately or in any combination. Claims 25 and 28 should also be allowable, at least due to their dependence from base claim 21.

The Examiner appears to have alleged that Capote discloses that the resin is "changed from liquid to solid when the bump electrodes are in a molten state," (Final Office Action at 6). Applicant disagrees and submits that Capote merely discloses that "the solder is reflowed while simultaneously the encapsulant hardens" (Capote, col. 4, lines 22-23), meaning that while the solder is reflowed, the encapsulant cures. Capote does not disclose or suggest a "resin molding ... formed of a resin having a flux function" or that "the resin is changing from liquid to solid when the bump electrode is in a molten state," that is, prior to curing, as required by independent claim 21.

Further, the Examiner alleged Capote discloses that “the resin has a coefficient of elasticity greater than 20 MPa” (Final Office Action at 6). Capote discloses that after cure, the modulus of “the first portion” is “greater than 0.1 GPa, preferably greater than 4 GPa” (Capote, col. 10, lines 51 and 57-58). However, the coefficient (or modulus) of elasticity recited in claim 21 (20 MPa, which is 0.02 GPa) is for “a state where the resin is changing from liquid to solid when the bump electrode is in the molten state,” (emphasis added) and therefore before curing. Therefore, any coefficient of elasticity disclosed by Capote cannot be compared with Applicants’ claimed coefficient.

In addition, even if one compared the post-cure coefficient of Capote to the pre-cure coefficient of Applicant’s invention, as the Examiner has done, Capote still does not disclose or suggest Applicant’s invention. The Examiner alleged that Capote discloses “a coefficient of elasticity greater than 20 MPa” (Final Office Action at 6). However, Applicant’s claimed elasticity value of 20 MPa (0.02 GPa) is much smaller than 0.1 GPa, *i.e.*, a full order of magnitude lower, which Capote discloses as the lowest preferable elasticity value. See Capote, col. 10, line 57. Thus, Applicant’s claimed elasticity value of 20 MPa (0.02 GPa) is well outside the range of the elasticity values disclosed by Capote as preferable. Therefore, for at least these reasons, Capote does not disclose or suggest the use of an elasticity value that is a mere fraction of Capote’s lowest preferable elasticity, and certainly does not disclose or suggest the claimed elasticity of 20 MPa or more.

The Examiner again admitted that “Capote does not teach a plurality of second bump electrodes” and cited Nagarajan in an attempt to cure the deficiencies of Capote.

As established regarding claim 1, Nagarajan does not disclose or suggest “at least one second bump electrode formed on a side of the wiring board opposite to the at least one connecting electrode, the at least one second bump electrode being electrically connected to the at least one connecting electrode,” as required by claim 21. Thus, Nagarajan does not cure the deficiencies of Capote, and the combination of Capote and Nagarajan does not render obvious claim 21.

The Examiner also cited Grill and alleged that Grill “teaches [a] chip having a low-K dielectric film ... and [a] wiring film formed thereon” and that “[i]t would have been obvious ... to provide low-K insulating films on the chip of Capote in order to reduce signal propagation delays in the device” (Final Office Action at 6). However, Grill is directed to “[a] method of forming a multilayer interconnect structure ... that include[s] interconnected conductive wiring and vias spaced apart by a combination of solid or gaseous dielectrics,” and which involves “forming air gaps” (Grill, Abstract, emphasis added). Thus, Grill appears to require the use of air gaps in dielectrics, a requirement that is present in any combination of Grill with other references. Thus, Grill, alone or in combination with other references, cannot render obvious Applicant's invention, at least for this reason.

The air gaps of Grill, merely added to the disclosures of any of Capote, Lin, or Nagarajan, would not render obvious Applicant's invention. The dielectrics of Grill are directed for use as intralevel dielectrics, i.e., dielectrics within a structure containing multiple levels of wiring traces and interlevel dielectrics. See Grill, paragraph [0003]. The dielectrics of Grill are not intended as dielectrics onto which a passivation layer, a

pad, a barrier layer, and a bump electrode would be formed. Thus, Grill's disclosure of forming gaseous dielectrics and air gaps within a multilayer interconnect structure is directed to a different part of a semiconductor device than is Applicant's invention, and is not relevant to Applicant's invention.

Further, Grill discloses an objective of reducing RC time constants and signal propagation delays. See Grill at paragraph [0004]. Grill discloses that air gaps are formed in the interlayer dielectrics in order to reduce the RC time constants. The issue of signal propagation delays may be relevant to interlevel dielectrics and to multilevel interconnect structures, but is not relevant to Applicant's disclosure of a dielectric onto which a passivation layer, a pad, a barrier layer, and a bump electrode are built. The disclosure of Grill is directed to a different issue (signal propagation delays), than the disclosures of any of Capote, Lin, and Nagaraian. Grill's disclosure also fails to overcome the above-noted deficiencies of any of Capote, Lin, or Nagaraian. Therefore, for at least these reasons, the combination of Grill with any of Capote, Lin, and Nagaraian, would not render obvious Applicant's invention, as recited in independent claim 21. Claim 21 should therefore be allowable over Capote, Lin, Nagaraian, and Grill. Claims 25 and 28 should be allowable at least due to their dependence from base claim 21.

Further, the Examiner alleged that some elements of claims 21, 25, and 28 contain "product by process" claim elements. Applicant disagrees and notes that no elements of any of claims 21, 25, and 28 recite "product by process" elements. Further,

as established above, MPEP § 2113 provides no support for rejecting claims that do not recite “product by process” elements as if the claims did recite such elements.

Thus, for at least these reasons, claims 21, 25, and 28 should be allowable over Capote, Lin, Grill, and Nagaraian separately or in any combination. Applicant therefore respectfully requests withdrawal of the rejection of claims 21, 25, and 28.

Rejection of Claims 23, 26, 29, 33, and 34

Independent claims 1 and 23 should be allowable over Capote, Grill, and Nagaraian, separately or in any combination. Claims 26 and 29 should also be allowable over Capote, Grill, and Nagaraian, at least due to their dependence from base claim 23.

The Examiner again admitted that “Capote does not teach a plurality of second bump electrodes” and cited Nagaraian. See Final Office Action at 10. For the reasons established above, the combination of Capote and Nagaraian fails to render obvious at least this feature of independent claim 1 and the corresponding feature of independent claim 23.

The Examiner cited Kelkar in an attempt to overcome the deficiencies of Capote, Grill, and Nagaraian. Specifically, the Examiner alleged that Kelkar “teaches a plurality of passivation layers having a pad of different material formed therein” (Final Office Action at 9). Kelkar is directed to preventing “cracks from propagating through the integrated circuit device” (Kelkar, Abstract) and discloses “a passivation layer 206” and that “[a] layer of resilient protective material 210 is formed over ... the passivation layer 206” (*Id.*, col. 4, lines 31 and 45-46). Nevertheless, Kelkar does not overcome the

deficiencies of Capote, Grill, or Nagarajan. For example, the combined teachings of Capote, Grill, Nagarajan, and Kelkar still fail to disclose or suggest “a low dielectric constant insulating film having a relative dielectric constant of about 3.5” or “the resin is changing from liquid to solid when the bump electrodes are in a molten state,” as recited in claim 1.

In addition, the combined teachings of Capote, Grill, Nagarajan, and Kelkar fail to disclose or suggest “a plurality of low K dielectric films ... [and] a plurality of passivation films formed on the low K dielectric films, each of the passivation films having a pad of a different material formed therein” as recited in independent claim 23. Capote, Grill, Nagarajan, and Kelkar in combination also fail to disclose or render obvious “the resin is changing from liquid to solid when the bump electrode is in a molten state,” as also recited in independent claim 23.

Thus, Capote, Grill, Nagarajan, and Kelkar, separately or in any combination, do not render obvious independent claims 1 or 23. Claims 1 and 23 should each be allowable over Capote, Grill, Nagarajan and Kelkar. Claims 26 and 29 should be allowable, at least due to their dependence from base claim 23.

As established, independent claim 1 should be allowable over Capote, Grill, Nagarajan, and Kelkar separately or in any combination. Independent claim 21, while differing in scope, recites similar limitations as claim 1, and should also be allowable over Capote, Grill, Nagarajan, and Kelkar separately or in any combination. Claims 33 and 34 should be allowable, at least due to their respective dependence from base claims 1 and 21.

The Examiner also apparently alleged that some elements of claims 23, 26, 29, 33, and 34 recite “product by process” limitations. See Final Office Action at 10. Applicant disagrees and submits that no elements of any of claims 23, 26, 29, 33, and 34 recite such limitations, and as established above, there is no support in MPEP § 2113 for the Examiner’s rejection of claims as if they recite “product by process” limitations, when they do not. Applicant therefore respectfully requests withdrawal of the rejection of claims 23, 26, 29, 33, and 34.

Rejection of Claims 30-32

As established above, independent claims 1, 21, and 23 should be allowable over Capote, Kelkar, and Grill, separately or in any combination. Claims 30-32 should therefore also be allowable over Capote, Kelkar, and Grill at least due to their respective dependence from base claims 1, 21, and 23.

The Examiner cited Hosomi against claims 30-32, asserting that Hosomi “teaches a barrier layer comprising successive layers of titanium, nickel, and palladium” (Final Office Action at 11). Regardless of whether Hosomi contains such disclosure, Applicant submits that the structure disclosed by Hosomi is very different than that of Applicant’s claimed invention. For example, Hosomi discloses “an Au bump formed on the semiconductor chip, and Cu lead bonded to the Au bump through a bonding part,” as well as that “[t]he Cu lead has a Cu core and a plated Sn layer formed on the Cu core,” (Hosomi, Abstract). Further, Hosomi fails to overcome the deficiencies of any of Capote, Kelkar, and Grill. Therefore, the combination of Capote, Kelkar, Grill, and Hosomi fails to render obvious independent claims 1, 21, or 23. Claims 1, 21, and 23

should each be allowable over Capote, Kelkar, Grill, and Hosomi, separately or in any combination. Claims 30-32 should therefore also be allowable, at least due to their respective dependence from base claims 1, 21, and 23. Applicant therefore respectfully requests withdrawal of the rejection of claims 30-32.

Conclusion:

Applicant respectfully requests that the Examiner withdraw the finality of the January 14, 2008 Office Action and consider the remarks presented herein, placing claims 1, 3, 6-8, 21, 23, and 25-34 in condition for allowance.

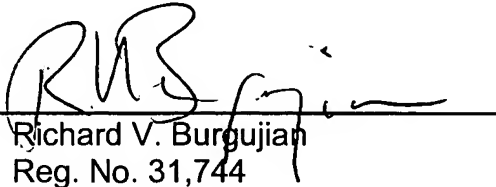
Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: April 14, 2008

By: _____


Richard V. Burgujian
Reg. No. 31,744